



# **Private Industry Role in Next Generation Internet**

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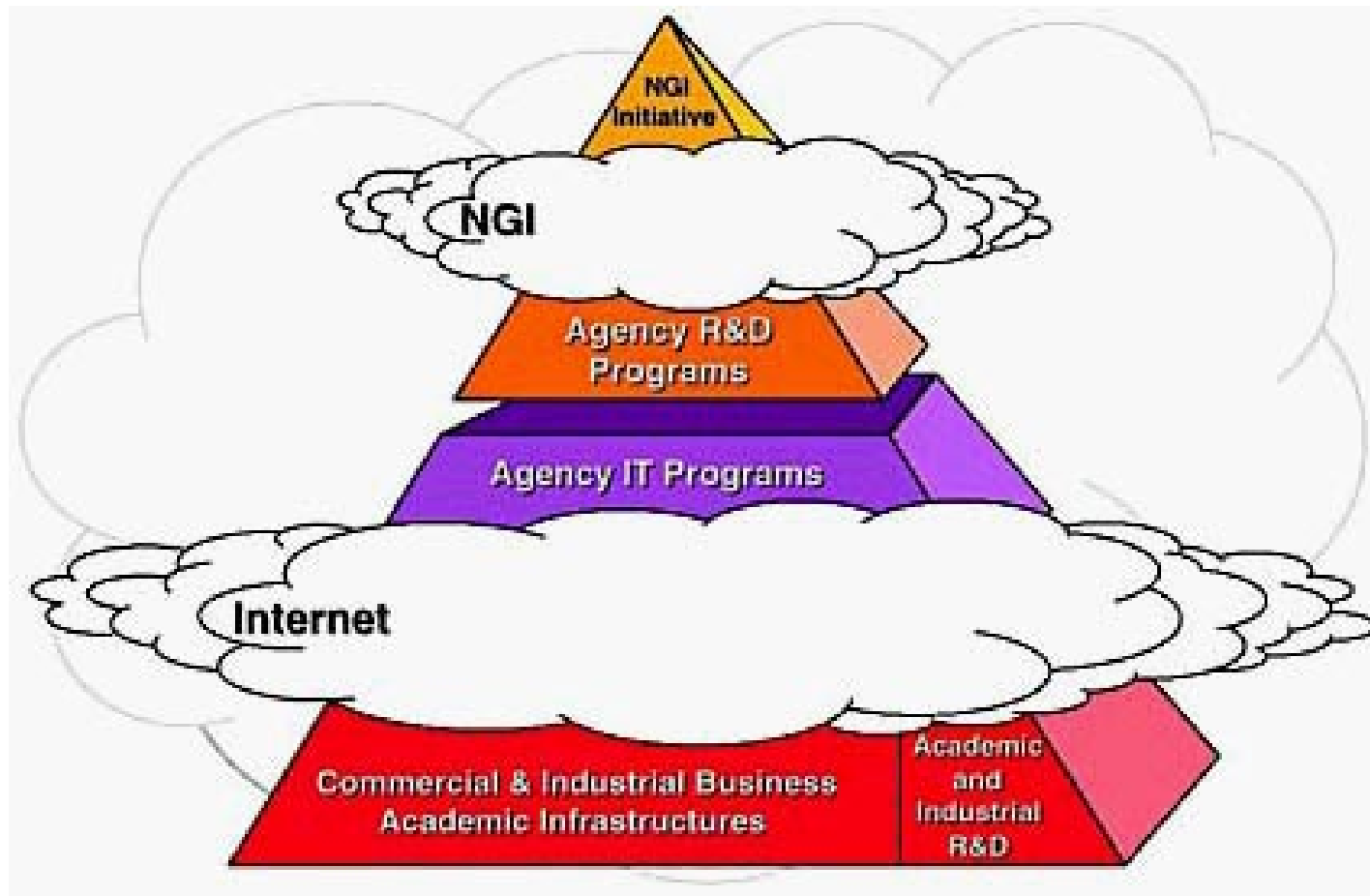
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**Large Scale Networking Working Group**

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# NGI: Foundation for the Future





## **Points to Remember**

- **Dynamic Virtual Networks are the Future**
- **Joint Industry, Government, and Academic R&D collaborations are essential for success**



## Goal 3 : Applications

- Applications
  - Medicine
  - Crises Management
  - Basic Sciences
  - Education
  - Environment
  - Manufacturing
  - Federal Services
- Characteristics
  - Distributed Computing
  - Remote Operation
  - Digital Libraries
  - Collaboratories
  - Privacy / Security



## Goal 2 : Technologies

- Network Engineering
  - Planning and Simulation
    - network planning language
    - run time tools
  - Monitoring
    - gathering data
    - network engineering
    - network management
    - run time (i.e. dynamic) analysis
    - QOS and drill down analysis tools
  - Integration
    - engineering tools, switching/routing, and transmission to work smoothly



## Goal 2 : Technologies ctd.

- Network Engineering ctd.
  - Data Delivery
    - routing / switching
    - best effort vs priority traffic
    - dynamic routing vs virtual circuits (VCs)
    - greedy admission vs guaranteed delivery
    - flat rate vs variable costing
    - multicast (reliable vs unreliable)
    - real time protocols and traffic



## Goal 2 : Technologies ctd.

- Network Engineering ctd.
  - Managing Lead User Infrastructure (fast, complex, dynamic)
    - Concurrent Production and Network Research traffic (virtual networks)
    - (de) aggregation of tributaries
    - operation and management strategies and tools
    - scaling ( speed, size, complexity )
    - user requirements that are orders of magnitude larger and more complex than normal applications and traffic



## Goal 2 : QOS (end-to-end)

- Baseline QOS Architecture
  - framework of models, languages and protocols to specify QOS
  - negotiate acceptable tradeoffs
  - receive feedback on delivered QOS (enable adaptation)
  - APIs supporting propagation of QOS constraints and feedback
  - admission control
  - accounting / costing
  - prioritization
- Drill Down Technologies
  - support QOS across ( “drill down” ) layers
  - expose interfaces to QOS and network capabilities
  - emphasis on OS< communication libraries, middleware services and distributed objects



## **Goal 2 : QOS (end-to-end) ctd**

- Next Generation Network Technologies  
(in addition to QOS)
  - RSVP
  - IPv6
  - Routing / Switching
  - Multicast ( IP and ATM )
  - Real Time protocols
  - admission control ( IP and ATM )
  - accounting / costing ( IP and ATM )
  - scheduling ( IP and ATM )
  - prioritization ( IP and ATM )



## Goal 2 : Security

- secure and fair means for users to access network resources (e.g. QOS)
- smart network management
- inter-network peering (e.g. surety of routing updates)
- nomadic/remote access
- Public Key Infrastructure (industry interoperable)



## **Goal 1 : 10 sites at 1000x**

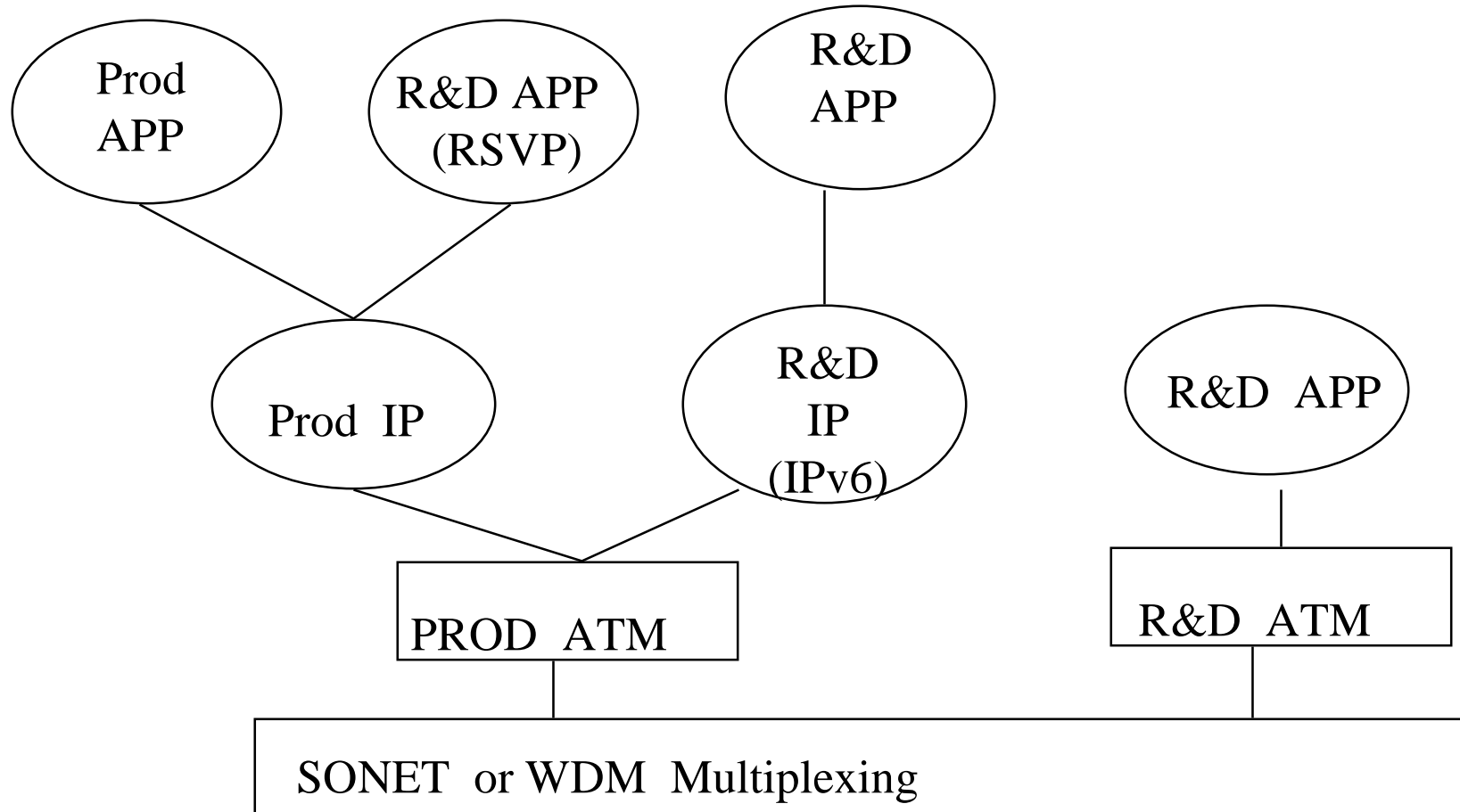
- end-to-end gigabits and terabits to Applications
- end system 1000x interfaces (e.g. HIPPI 64)
- Operating System (OS) and end system architectures
- 1000x network management tools / capabilities
- (de) aggregation of high speed tributaries
- WDM at WAN, LAN and Local Loop
- optical, electrical, hybrid hardware
- interconnect to 100x networks



## **Goal 1 : 100 sites at 100x**

- end-to-end 100 megabits and up
- 100+ Universities, Labs, and Federal Centers
- supports applications (goal 3) using advanced network technologies (goal 2)
- IPv4 minimum bearer service
- IPv6 in future
- ATM and other services as required (VPNs)
- Gigapops (aggregation points)
- vBNS is I2 and Gigapop interconnect fabric
- concurrent production and network research

## MORPHNET(Virtual Networks)





## **Goal 1:100 sites at 100x ctd**

- **Interconnection**
  - at L2 and L3 among Federal Networks / Carriers
  - QOS ( IP and ATM)
  - Management tools and capabilities ( NOCs, Helpdesks, ...)
  - Monitoring, Analysis and Accounting (settlements) tools
  - routing / peering exchanges between Federal networks and Federal networks at Gigapops (when appropriate)
  - Flexible and dynamic methods for setting up interagency virtual networks



## **Goal 1 : 100 sites at 100x ctd**

- **Network Management**
  - distributed help desk
  - security and authentication methods
  - gigapop and agency network NOCs ( NOC to NOC )
  - applications can schedule bandwidth and services
  - network management tools ( existing and new)

## Summary

- Need joint commercial, government, and university R&D ventures to define and build the future Network and services
- End users need capabilities to “see” and “control” the Network
- The Network is :
  - switches, routers, muxes
  - lines, circuits, services
  - end systems, operating systems, libraries
  - applications
  - people, relationships





## More Information ...

- **Next Generation Internet**
  - <http://www.ngi.gov>
- **Internet 2 (university consortium)**
  - <http://www.internet2.edu>
- **NASA Research and Education Network**
  - <http://www.nren.nasa.gov>
- **DOE**
  - <http://www.es.net>
  - <http://www.anl.gov/ECT/Public/research/morphnet.html>
- **DARPA**
  - <http://www.ito.darpa.mil/ResearchAreas.html>
- **NSF's Connections**
  - <http://www.vbns.net>